



UNDERGROUND CERTIFICATES IN NOVA SCOTIAN
COAL-MINES.

A PAPER READ BEFORE
THE INSTITUTION OF MINING ENGINEERS.

BY

E. GILPIN, JUN.,
H.M. INSPECTOR OF MINES.

ANNUAL GENERAL MEETING AT BIRMINGHAM,
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In the Dominion of Canada no general provision is made by the Federal Government for education. Each province adopts the system apparently most suitable for the needs of its inhabitants. This arrangement was made at the time of confederation, in order that the privileges which each province had secured in the way of free education should not be endangered from an outside source, and possibly interfered with by an irresistible power. In Nova Scotia, almost one-third of the scanty annual provincial revenue is expended in assisting the various sections in providing educational facilities ; and this freedom of action has enabled the province to provide agricultural, horticultural and teachers' schools, and to subsidize other educational organizations.

Public attention in the province had been specially directed to coal-miners on account of the serious accidents that happened from time to time, and the struggles between capital and labour. As a result of a long and bitter strike, labour unions were formed at all the mines and federated under a general council. Many persons, even well-wishers of the men, prophesied evil from these unions ; but time, however, has shown that when the lodges have been officered by reasonable and fair-minded men the results have been favourable.

To their credit it is to be said that, through their representative, the Hon. Robert Drummond, arguments were brought to bear on the government in favour of a total change in the system of management of coal-mines. It was admitted that, as a class, the mine-managers, who generally also discharged the duties of agents, were men equal to their business ; but it was contended that the men who practically controlled and directed the underground operations were not infrequently lacking in general knowledge and of limited experience, and that important positions were given to men whose chief merit was a willingness to carry out orders. Finally, it was determined to grant certificates of service to all who had for a certain number of years filled the position of under-

ground manager or overman, and that in future any person filling these positions should be the holder of a certificate of competency. A board of examiners representing mine-owners, workmen and the mining engineering profession was formed, and local instructors were appointed in sufficient number to ensure facilities for attendance to any would-be pupils. This system was afterwards extended to include mine-managers.

As all of the candidates were required to be at least 21 years of age, and many were over that age, it was evident that the pitboy's education, often finished as he entered his teens, was not a good ground for the instructor to work upon. In order that he might not be required to impart rudimentary education, provision was made so that in all mining localities night-schools could be formed on petition by intending pupils. The district teachers and schools were utilized by the government for this purpose. These measures furnished a fairly comprehensive scheme, which has worked satisfactorily for a number of years.

Since 1882, 32 certificates of service have been granted to underground managers and overmen, and 293 certificates of competency. Fifty certificates of service and of competency have been granted to managers since 1891.

As a matter of comparison, the writer gives at the end of this paper a recent set of questions. Many workmen barely able to write, and with only an elementary knowledge of arithmetic, have passed the three successive stages, and are to-day in charge of pits, running with haulage-plants, compressed air, electric plants, etc. Thus A passed as overman in 1891, as underground manager in 1893, and as manager in 1897, and so on. Many of course have not advanced beyond the overman's certificate. Some little friction was experienced in introducing this new order of things, a friction more evident in a small province where political and personal influence could be exercised to a greater degree than would be the case in Great Britain; but now the owners of the coal-mines feel that they can select more efficient officials from those holding certificates than they could formerly from their lists of men available for promotion. At present, taking the figures already given, we have 325 men holding certificates of competency as underground managers and overmen, and last year an average of 2,144 skilled workmen were employed underground, not counting boys and labourers.

An Act was passed in 1891 (section 11, chapter 9, Acts 1891), as follows :—

Where there is a shaft or an inclined plane or level in any mine, whether for the purpose of an entrance to such mine or of a communication from one part to

another part of such mine, and persons are taken up or down or along such shaft, plane or level by means of any engine, windlass or gin driven or worked by steam or any mechanical power, or by an animal, or by manual labour, a person shall not be allowed to have charge of such engine, windlass or gin, or of any part of the machinery, ropes, chains or tackle connected therewith, unless he is a male of at least 18 years of age. Nor shall any person have charge of such engine, windlass or other hoisting apparatus, unless he has undergone an examination by a person or board to be appointed by the Governor-in-Council, and holds a certificate of competency based on said examination. Certificates of service may be granted until January 1st, 1892, and this section shall not go into operation till that date.

By this enactment, provision was made for the examination of men employed in running engines for raising and lowering persons in the coal-mines. A board of three practical mechanical engineers was appointed, and instructors were placed wherever enough pupils offered. Three grades were recognized among those passing. This division has perhaps proved too minute, and it may be found that two classes of certificates would prove enough. The author appends a set of questions fairly illustrating the tenor of the examinations.

The ground being now fairly covered as far as the underground officials and one of the most important divisions of the workmen were concerned, there remained a logical step. The safety of the workings depending as much on the intelligence of each individual workman as on the efficiency of the overmen, it is evident that any step tending to exclude undesirable or inexperienced men from the working-faces made towards strengthening the complete chain of all engaged in the extraction of coal. It is true that the carelessness or ignorance of an individual miner most often is reflected disastrously on his own shoulders, but he frequently also involves in disaster his loader or driver, or more rarely initiates a wide-spreading calamity.

However, in this province the question of securing some test of the ability of the individual miner came rather from practical considerations than from any logical outcome of the steps already taken.

In Nova Scotia, for many years, coal-mining was practically at a standstill for about four months of the year. This was due to the closing of the St. Lawrence river by ice during the winter and the enforced accumulation during the summer at all ice-bound points of the necessary winter stocks, and to the expense of keeping open the harbours and the absence of railroads to more distant markets and ports of outlet. This state of affairs has gradually changed, so that on the mainland shipments and work go on throughout the year, and it is expected in Cape Breton that trade with the United States of America will soon permit of

all winter-shipments *via* Louisburg, now connected with the Cape Breton coal-field by a colliery railroad of a higher standard than any yet constructed on this continent or in Great Britain.

This cessation of work led to many men working their little farms or lumbering in the winter, and cutting coal during the summer. Other miners stayed at the mines, and received more or less work during the winter. There were thus formed two classes of miners, and when the rush of business came in the summer, men were employed in coal-cutting, even in gaseous mines, who were certainly not experienced miners, nor likely to become so, as they looked upon their underground work merely as an interlude in their home employment.

Finally, the following amendment was made to the Mines Regulation Act of 1891, section 15, chapter 9 (sub-section to be added to section 40) :—

And in no mine to which this chapter applies shall any person not now employed as a miner be "given the picks" to work as a miner unless he has been employed in a mine, in some capacity, for the space of one year. No one shall be given charge of a working-face in a mine who has not worked previously in a mine for the space of two years, nor shall any one now a miner be employed after the 1st of January to mine coal who is not a holder of a certificate of service; and no one not now a miner shall be "given the picks" to work as a miner until granted a certificate of competency after examination by the Board of Examiners appointed for the purpose of granting certificates as managers, overmen or shot-firers, or by an examining board to be hereafter appointed, who shall have power to frame laws and conditions under which said certificates shall be granted.

It was claimed, by many, that the practical result of this legislation would be a miners' close guild, and that it would become difficult to find enough men to dig coal during any sudden demand. The Act came into force on January 1st, 1892. The output that year was 1,942,780 tons, and in 1897 the output was 2,300,916 tons. So far, no trouble has been experienced in finding an ample supply of men.

The machinery for carrying out this Act is of the simplest description. A board of two men of practical experience in coal-mining is appointed at each colliery, which holds examinations and issues certificates at short intervals. Returns are made quarterly to the Department, giving the names of persons receiving certificates and the grade of certificate.

The result of the enforcement of this system of certificates has been, so far, very satisfactory. A miner of dissipated habits is liable to have his certificate cancelled by the board, or he can be dismissed by the management under the law, without incurring the resentment of his fellow-labourers. It is claimed, and the writer thinks justly, that the

educational facilities placed within reach of the miners have made them more provident and steady. The old-time drinking and disorder of pay-days is almost unknown, except among the young labourers who come to the mining districts from the country. In the mining village of Stellarton, one of the oldest in Nova Scotia, during the past year the fines for disorderly conduct were nominal.

Further, these preliminary *viva-voce* examinations have paved the way to candidates for the overman and other certificates, and, generally speaking, have impressed a sense of responsibility upon the younger miners growing up for certificates.

The following Order in Council published on December 2nd, 1892, marked the commencement of the issuing of certificates to miners :—

The persons so appointed shall form the Board of Examiners for their respective districts, and shall hold, as often as may be required, examinations, at which persons desiring certificates of competency shall present themselves. The examinations shall not be by written answers to questions, unless so required by the Commissioner of Public Works and Mines. The examinations must show to the satisfaction of the examiners that the candidate possesses a knowledge of ventilation, modes of working coal, of timbering, of gas, of safety-lamps, of the requirements of the Mines Regulation Act and Special Rules sufficient to enable him to work properly as a miner or shot-firer, before a certificate be granted.

In the case of applications for certificates of service, the examiners shall satisfy themselves of the *bona fides* of the applicants, and may require such proof of service as is necessary for carrying out the requirements of the law in this respect. The examiners shall not grant a certificate of service or competency to any person of known bad character, and a certificate may be cancelled or suspended by the Commissioner of Public Works and Mines upon representation to him by a Board of Examiners that the holder of such certificate is guilty of drunkenness or other misconduct, and a Board of Examiners shall, to enable it to report to the Commissioner of Public Works and Mines, make enquiry forthwith into the truth of any such charge brought to its notice.

The fee to be paid by each person receiving a certificate shall be 50 cents [2s. 1d.], to be paid to the Examining Board, and to be divided between the two examiners. The forms of certificate, registration, etc., shall be such as the Commissioner of Public Works and Mines may from time to time direct. The certificates, books and forms, will be provided for the Boards of Examiners, and an annual allowance of \$20 [£4] will be paid to each board of examiners for postage and stationery, but all other expenses will be defrayed by each board.

The Commissioner of Mines may make such rules for the Boards of Examiners as may be found necessary for carrying on their work, and these rules may be at any time revoked or changed, or new ones made by the Commissioner of Public Works and Mines, who shall have power to do whatever is herein overlooked, or may hereafter be required, for the more efficient carrying out of the law.

The writer adds to his paper a copy of the portion of the Act (Appendix VII.) referring to underground officials, and a set of the forms of certificates issued to miners and shot-firers (Appendix VIII.).

APPENDIX I.—AN ACT RESPECTING SCHOOLS OF INSTRUCTION FOR MINERS,
PASSED ON APRIL 17TH, 1889.

Be it enacted by the Governor, Council and Assembly as follows :—

1.—The Governor-in-Council may authorize the establishing of a school of instruction for miners at any place in the province at which coal-mining operations are carried on, for the purpose of instructing persons who may wish to prepare themselves to undergo examination before the Board of Examiners referred to in section 8 of chapter 7, revised statutes, and may appoint teachers for such schools, and may fix the time for which such teachers shall hold their appointments.

2.—The teachers of the schools established under the provisions of the first section shall prepare candidates in accordance with the rules now prescribed, or which hereafter may be prescribed, by the Board of Examiners, or with such rules as may be made by the Governor-in-Council.

3.—Each teacher preparing and sending up for examination not less than two properly qualified candidates shall be entitled to a fee or retainer of \$100 [£20] per annum from the province. If it shall appear to the satisfaction of the Commissioner of Public Works and Mines that the failure of candidates to pass the examination was not due to any default of the teacher, such teacher shall be entitled to the said fee or retainer, notwithstanding the candidates' failure.

4.—Any teacher who has prepared candidates who have successfully passed the Board of Examiners shall be entitled to such fees for each candidate passed as an overman or underground manager as may be fixed by the Governor-in-Council, such fees to be paid by the Commissioner of Public Works and Mines on the certificate of the chairman of the Board of Examiners.

5.—No teacher shall be allowed to exact from any intending candidate any fee for the instruction given by him ; provided, however, that this shall not apply to any person desiring instruction, but not contemplating examination.

6.—The standard of efficiency and system of marks and of examination shall be the same as that now in force, or that may hereafter be decided upon by the Board of Examiners.

7.—No fee shall be charged by the Board of Examiners to candidates who have been prepared at any school established under authority of this Act.

8.—The Governor-in-Council shall cause each teacher of the schools of instruction for miners to be supplied with a proper outfit of instruments, to be used for the purpose of instruction. Such instruments shall be held as the property of the province, and the teacher, whenever so requested, shall return them to the Commissioner of Public Works and Mines, and shall make good any damage beyond reasonable wear and tear.

9.—The rent of rooms or buildings, the cost of fuel and light, and other incidental expenses in connexion with the schools, shall be a provincial charge, and shall be paid by the Commissioner of Public Works and Mines.

10.—The Governor-in-Council shall have power to make from time to time such regulations as may be necessary or useful in making the said schools of instruction effective for their purpose.

11.—The schools of instruction for miners at present in operation, established by order of the Governor-in-Council, are hereby declared to be established under the provisions of this Act.

APPENDIX II.—MEMORANDUM *re* EXAMINATIONS FOR ENGINEERS.

There are three classes of certificates:—First, second and third.

Qualification as to age.—A candidate for any grade must be at least 18 years of age, and, if required by an examiner, produce a certificate to that effect from his parents or guardian, or some reputable person.

A candidate for the third or lowest grade must have served as fireman or engineman, or both, for a period of at least 12 months.

For the second grade, the candidate must have served in connexion with engines and boilers for a term of not less than 2 years.

For the first grade, the candidate must be a holder of a second or third-class certificate, and have had at least 2 years' practice in making or repairing engines.

In all cases the certificates of employment must be satisfactory to the examiner.

In the case of any examination, should the candidate not secure enough marks to reach a higher grade, he can obtain a lower-grade certificate, provided that he has secured enough marks for to entitle him to such lower-grade certificate.

The examination will be conducted by means of written answers to written questions, and be supplemented by *viva-voce* examination, if deemed necessary. The questions for the three grades will be on one paper, and a specified number will be taken by the candidates for each grade, as deemed proper by the Board.

In any examination, the candidate must secure at least 50 per cent. of the number of marks allotted to the questions selected by him in order to receive a certificate.

The local examiner will, upon application, furnish a form as to age, employment, etc., to be filled up and returned to him at least 20 days before the date of the examination.

APPENDIX III.—ENGINEERS' EXAMINATION.—MEMORANDUM FOR CANDIDATES.

Applicants for a third-class certificate will take the papers A and B.

Applicants for a second class and who do not already hold a third class will take the papers A, B, C, D and G, but if they have a third class, C, D and G will be sufficient to secure a second class.

Applicants for a first class who do not already hold a second class will take the papers C, D, E, F, G and H, but if they have a second class, E, F and H will be sufficient to secure a first class.

Applicants for the third and second class must secure at least 55 per cent. of the number of marks allotted for each question.

Applicants for the first class must secure 75 per cent.

Paper A.—Boiler Questions.—Third Class.

1. What would be your first duty on taking charge of boilers?
2. Which needs the most care and constant attention, the engine or the boiler?
3. Why so?
4. Into what two general classes may boilers be divided?
5. Describe an internally fired boiler?
6. How many gauge-cocks should be used, and how should they be placed?
7. How high should the water be carried?
8. Suppose that, owing to a break down of the pump or of the injector, or any other cause, the water should get so low as to disappear in the glass gauge and lowest gauge-cock, and you had no means at hand with which to get more water into the boiler, what would you do. Would it be advisable to raise the safety-valve?

9. What would you do if your glass gauge were to burst?
10. Suppose you found your new glass 1 inch too long, how would you cut 1 inch off, quickly and neatly?
11. What would you do after you put the new glass in?
12. Would you trust your glass gauge entirely?
13. If the gauge-cocks should get stopped up, how would you clear them?
14. What is a safety-valve?
15. How many kinds or types of safety-valves are in general use?
16. Will not a lever safety-valve stick fast in its seat sometimes?
17. What is a check-valve, and what are its functions?
18. Do not check-valves sometimes get caught up so that they will not seat, and what is the result?
19. Will you name in what particular way boilers are generally neglected and abused?
20. What precaution should be taken in opening or closing any kind of valve, be it safety-valve, throttle-, stop-, or blow-valve?
21. When intending to blow out for repairs or scale, what would you do?

Paper B.—Engine Questions.—Third Class.

1. What do you consider the first qualification for one who runs a steam-engine, to possess?
2. Should not an engineer be a machinist by trade?
3. How and where can one learn about machinery outside of the shops?
4. How often would you oil an engine?
5. Suppose you had a sight-feed on the cylinder, and automatic cups on the journals, would you still go around oiling with your oiler?
6. Which is the proper way to key up, or screw down a journal?
7. What are an engineer's duties while on watch?
8. How are steam-engines rated?
9. What is a horsepower?
10. What do you understand by mean effective pressure?
11. How do you find the piston-speed of an engine?
12. What is friction?
13. Does friction increase with the extent of the rubbing-surfaces?
14. What is the object of cylinder-clearance?
15. What precaution should be used in reference to cylinder-clearance?
16. After keying or lining up the connecting-rod, what precautions would you use?
17. Explain the difference between condensing and non-condensing engines.

Paper C.—Boiler Questions.—Second Class.

22. How can an engineer set a safety-valve in a practical manner without the aid of mathematics?
23. Can smoke be burnt by any means?
24. What will cause a boiler to be a poor steam-maker, and be inefficient, wasteful of fuel, etc.?
25. Should land-boilers be inspected by some responsible boiler-inspector?
26. What is steam?
27. Why do you say that it is invisible? Can we not see it plainly as it issues from the exhaust-pipe of a non-condensing engine?
28. What is meant by wet steam?
29. Is not wet steam a source of danger?

30. What is the cause of wet steam ?
31. How can you tell when the boiler is foaming badly ?
32. What would you do in such an emergency ?

Paper D.—Engine Questions.—Second Class.

18. What are the mechanical powers ?
19. What is meant by mechanical power ?
20. Explain in simple language the gain by expanding steam ?
21. Suppose you had an engine in which a set-screw was used on the eccentric, and the eccentric not marked, and that eccentric should slip, and there was no time to go through the usual methods of setting valves, as hundreds of men were waiting ; and the work had to be done at once : what would you do ?
22. What is the horse-power of a 16 inches by 36 inches engine running 50 revolutions per minute with 45 pounds mean effective pressure ?
23. What are the relative positions of the crank and the eccentric ?
24. When the cut-off is independent and rides upon the back of the main valve, what is the relative position of its eccentric to the crank ?
25. How is such a cut-off generally adjusted ?
26. Should all the brasses of an engine be taken off and examined occasionally ?

Paper E.—Boiler Questions.—First Class.

33. How would you find the area of a safety-valve for any given size of boiler ?
34. What is the difference between a hard patch and a soft patch ?
35. On what portions of the boiler would you place a hard patch ?
36. What precaution must be taken in putting on a hard patch ?
37. What is the first thing to do when a crack is noticed ?
38. How are steam-boilers tested for strength ?
39. Why is it that so few marine boilers explode ?
40. Suppose a cap leaked while steam was up, would you attempt to tighten up the cap-nut ?
41. When should the hydrostatic test be applied to boilers ?
42. How should a safety-valve be constructed and attached to a boiler ?
43. Which is the best way to run an escape-pipe from a safety-valve ?
44. Give a simple rule for calculating the heating-surfaces of steam-boilers ?
45. How can the horsepower of a boiler be estimated roughly ?
46. How should steam-boilers be worked with a view to economy and safety ?
47. What is the bursting and safe working-pressure of a boiler, 60 inches in diameter, 30 feet long, longitudinal seams, double-riveted, plates $\frac{3}{8}$ inch thick, best mild steel, tensile strength 50,000 lbs. ?

Paper F.—Engine Questions.—First Class.

27. How would you set a slide-valve ?
28. What horsepower would be required for a fan to produce 200,000 cubic feet of air per minute, the water-gauge reading 2 inches, if the useful effect be 60 per cent. ?
29. Explain what is an indicator.
30. How would you proceed to apply an indicator ?
31. Explain the indicator-diagram now before you, and compute the indicated horsepower of same.

Paper G.—Pump Questions.—Second Class.

1. Explain the term "suction" of a pump.
2. From what causes is an imperfect vacuum most likely to arise?
3. Suppose a vacuum-gauge showed 30 inches, would not that prove a perfect vacuum?
4. Can you pump hot water with a pump?
5. What causes pump-valves to pound sometimes?

Paper H.—Pump Questions.—First Class.

6. Give your reason why all duplex straight-line pumps should have four steam-ports.
7. What is the proper lift for any conical or circular valve, be it a check, safety, or other kind of valve?
8. What position should the air-pump occupy relatively to the condenser?
9. How much condensing water is required per horsepower of engine?
10. How many gallons of water will a cistern or dam 170 feet long by 10 feet high and 12 feet wide contain?
11. How long would it require to fill the above cistern or dam with a single double-acting plunger-pump, each plunger being 6 inches in diameter, having a stroke of 24 inches, and making 140 feet per minute?

APPENDIX IV.—MANAGERS' EXAMINATION.

Paper I.—Geology.—(Time, 1 hour.)

1. What advantage has a knowledge of geology for miners?
2. In a search for minerals, what help may a knowledge of fossils bring?
3. Describe and illustrate a fault.
4. What does the term "denudation" mean?
5. Sketch an overlap of strata.
6. Distinguish between stratified and igneous rocks.

Paper II.—Mechanics.—(Time, 2 hours.)

1. What is meant by the co-efficient of friction of an engine?
2. What thickness of plate would you give to a Lancashire boiler 6 feet in diameter by 30 feet long, carrying a pressure of 45 lbs. per square inch? The boiler to be double-riveted. Give reasons.
3. What is the nominal horsepower of a plain cylindrical boiler 30 feet long by 5 feet in diameter?
4. By sketch, show how you would fasten a round steel rope, $1\frac{1}{2}$ inches in diameter, to a cage.
5. Find the horsepower of a hauling-engine for a plane 2,000 yards long, and with a rise of 4 inches to the yard for an output of 1,000 tons in 10 hours. Make allowance for friction.
6. What precautions would you take if, through a deficiency of water, a boiler became overheated?
7. What is the proper treatment to ensure a long life to wire-ropes?
8. What quantity of water would pass through a 6 inches pipe 5,000 feet long, with a head of 50 feet?

Paper III.—Ventilation.—(Time, 3 hours.)

1. A mine has two airways, one 5 feet by 8 feet and the other 5 feet by 6 feet, with equal volumes of air passing. The 5 feet by 8 feet airway is 1,000 feet long. How long will the other airway be?

2. If a water-gauge of 1·10 inches gives a current of 20,000 cubic feet of air per minute, what will be the water-gauge with 30,000 cubic feet per minute?
3. A water-gauge of 1 inch and 50,000 cubic feet of air are produced by a fan and steam-pipes in the upcast. The steam-pipes alone produce 10,000 cubic feet. What quantity will the fan give, if the steam-pipes are transferred to the downcast pit?
4. A fan at 50 revolutions produces 100,000 cubic feet of air with 2 inches of water-gauge, what will be the water-gauge, the number of revolutions, and the horsepower when the production increases to 120,000 cubic feet of air per minute?
5. A ventilating-current is passing at 5 feet per second. What increase of power will be required to double the velocity?
6. The temperature of a downcast is 40° Fahr., that of the upcast being 70° Fahr. What volume of air in the upcast will weigh the same as 1 cubic foot in the downcast?
7. The pillars about the shaft-bottom are to be 120 yards square from the shaft in all directions. Show by a large sketch, giving dimensions with description, how you would arrange the airways during the formation of the pillars. The coal gives off fire-damp freely.

Paper IV.—Modes of Working.—(Time, 3 hours.)

1. What instructions would you give to shot-firers in coal-mines?
2. Describe the safety-lamp that you like best, and name the make that you prefer for use at the working-face, on hauling-roads, and for official examinations.
3. Describe a method for securing a circular shaft with wood. Give the sizes of timbers for a shaft 10 feet in diameter.
4. Sketch and describe different methods of timbering a main-road in a flat seam.
5. Describe arrangements for getting coal from the working-faces to the main-roads underground in mines with considerable dip, and mention precautions to ensure the safety of the workmen.
6. Describe fully some system of underground-haulage, and mention the conditions in the mine that would govern your selection of that particular system.
7. On opening a seam of coal in a new field unaffected by old workings, what conditions would lead you to advise the selection of bord and pillar in preference to longwall?
8. Sketch, with measurements, the openings about a pit-bottom laid out for longwall.

Paper V.—Surveying.—(Time, 2½ hours.)

1. Lay down the following underground survey on the scale of 2 chains to 1 inch:—

Distance.	Chains.	Horizontal Angles.
Shaft to A.	1·90	A 145° 15'
A. B.	6·75	B 177° 30'
B. C.	4·30	C 213° 54'
C. D.	9·77	D 97° 20'
D. E.	3·90	E 130° 13'
E. F.	6·13	F 167° 30'
F. G.	3·01	

NOTE.—The horizontal angles are those on the left hand of a person travelling in the direction of the survey, and the magnetic bearing of the

line F. G. is 30° east of north. Also reduce the above readings to one meridian, and plot your proof. Explain how you would correct the above survey if made in a seam considerably inclined.

2. Work out the following series of levels and plot in the form of a section. Horizontal scale, 1 chain to an inch. Vertical scale, 20 feet to an inch. Datum line, 50 feet.

Distance. Chains.	Back Sight. Feet.	Fore Sight. Feet.	Distance. Chains.	Back Sight. Feet.	Fore Sight. Feet.
0·70 ...	1·30 ...	8·85	5·40 ...	8·80 ...	1·12
1·50 ...	8·85 ...	2·30	7·00 ...	2·32 ...	7·05
2·45 ...	13·96 ...	5·40	9·40 ...	1·33 ...	9·96
3·60 ...	5·40 ...	0·52	10·20 ...	3·34 ...	5·87
4·05 ...	12·62 ...	8·80	11·35 ...	5·87 ...	9·10

3. What are the special advantages and disadvantages in the use of the ordinary miners' compass as compared with the theodolite?
4. How may underground and surface-surveys be connected (1) when access is had through workings open to the surface, and (2) when by shaft only?
5. Describe a simple method of determining approximately the true meridian.

APPENDIX V.—EXAMINATION OF CANDIDATES NOT HOLDING A CERTIFICATE.

Paper I.—Mines Regulation Chapter.—(Time, 2½ hours.)

1. Upon whom are penalties imposed for non-compliance with the Act, and for what offences?
2. When is it necessary to work a mine with safety-lamps, and what examinations are then required?
3. Respecting single shafts, what does the Act say?
4. What restrictions are put on the working of coal under the sea?
5. What are the regulations respecting the fencing off of certain workings?
6. Who may not be employed about machinery, above or under ground? and give reasons.
7. State the law respecting explosives, and fully state the conditions in a mine that would govern the application of each section of the law.
8. What restrictions are placed on the operations of prospectors?

APPENDIX VI.—UNDERGROUND MANAGERS' AND OVERMEN'S EXAMINATION.

NOTE.—Papers 1 and 2 of managers' examination are not given to under-managers or overmen.

Paper III.—Ventilation.—(Time, 3 hours.)

1. What is an air-crossing? and give the size to pass 5,000 cubic feet of air per minute.
2. In an airway, 9 feet by 7 feet, the anemometer makes 425 revolutions per minute? What quantity of air is passing?
3. The temperature in a downcast is 40° Fahr., in the upcast 70° Fahr. What volume of air in the upcast will weigh the same as 1 cubic foot in the downcast?

4. The upcast and the downcast shafts are 500 yards apart. Twenty men are employed in a section of working situated 700 yards from the downcast and 450 yards from the upcast. The downcast takes fire. How would you propose to rescue the men? and how many men would you send in each rescue-party?
5. A ventilating-current is passing at 5 feet per second. What increase of power will be required to double the velocity?
6. In a mine giving off a good deal of gas 200 persons are employed, and the intake airway is 5,000 yards long. What size would you have the airway? and give your reasons.
7. The shaft-pillars are to be 120 yards square from the shaft in all directions. Show by large sketch, giving dimensions with description, how you would arrange the airways during the formation of the pillars. The coal gives off fire-damp freely.

Paper IV.—Modes of Working.—(Time, 3 hours.)

1. What instructions would you give to shot-firers in coal mines?
2. Describe the safety-lamp that you like best, and name the make that you prefer for use at the working-face, on hauling roads, and for official examinations.
3. Describe a method for securing a circular shaft with wood. Give the sizes of timbers for a shaft 10 feet in diameter.
4. Sketch and describe different methods of timbering a main road in a flat seam.
5. Describe arrangements for getting coal from the working-faces to the main-roads underground in mines with considerable dip, and mention precautions to ensure the safety of the workmen.
6. Describe fully some system of underground haulage, and mention the conditions in the mine that would govern your selection of that particular system.
7. On opening a seam of coal in a new field unaffected by old workings, what conditions would lead you to advise the selection of bord and pillar in preference to longwall?
8. Sketch, with measurements, the openings about a pit-bottom laid out for longwall.

Paper V.—Surveying.—(Time, 2½ hours.)

1. What is meant by the term true meridian? Describe a simple method for approximately determining it.
2. How may underground and surface-surveys be connected: (1) when access is had through workings open to the surface; and (2) when by shaft only?
3. Explain, by writing, how to level and plot a section.
4. What are the special advantages and disadvantages in the use of the ordinary miners' compass as compared with the theodolite?
5. Lay down the following survey on the scale of 2 chains to an inch:—

Distance.		Chains		Horizontal Angles.
Shaft to A. ...	...	1.90	...	A 145° 15'
A. B. ...	...	6.77	...	B 177° 30'
B. C. ...	...	4.30	...	C 213° 54'
C. D. ...	...	9.77	...	D 97° 20'
D. E. ...	...	3.90	...	E 130° 13'
E. F. ...	...	6.13	...	F 167° 30'
F. G. ...	...	3.01		

The horizontal angles are those on the left hand of a person travelling in the direction of the survey, and the magnetic bearing of the line F. G. is 30° east of north.

Paper VI.—Scholarship.—(Time, 2½ hours.)

1. Multiply $2\frac{1}{2}$ by $4\frac{1}{2}$.
2. Divide 4·675 by 0·3.
3. Find $\sqrt{3\cdot001}$.
4. What are the area and circumference of a circle whose radius is 4 feet?
5. A., B. and C. work together in a place 6 feet by 9 feet, they dig 200 feet ahead and are paid 50 cents per cubic yard. A. works 20 days, B. works 22 days, and C. works 24 days. How much does each receive?
6. What is the weight of 1 cubic yard of ironstone that has a specific gravity of 4·75?
7. What is the equivalent horsepower of 2,965,000 units of work per minute?
8. What must be the diameter of a working-barrel to pump in 12 hours as much water as one 12 inches in diameter does in 20 hours? Both going at the same speed.

APPENDIX VII.—EXTRACT FROM MINES REGULATION ACT, NOVA SCOTIA,
RESPECTING MANAGERS, UNDERGROUND MANAGERS AND OVERMEN.

40.—Every coal-mine to which this chapter applies shall, after the first of January (1890), be under the control and supervision of a manager, and the owner or agent of every such mine shall nominate himself or some other person to be the manager of such mine, and shall send written notice to the Commissioner of the name and address of such manager. And in no mine to which this chapter applies shall any person not now employed as a miner be “given the picks” to work as a miner unless he has been employed in a mine, in some capacity, for the space of one year. No one shall be given charge of a working-face in a mine who has not worked previously in a mine for the space of two years, nor shall any one now a miner be employed after the first of January to mine coal who is not a holder of a certificate of service; and no one not now a miner shall be “given the picks” to work as a miner until granted a certificate of competency after examination by the Board of Examiners appointed for the purpose of granting certificates as managers, overmen or shot-firers, or by an examining board to be hereafter appointed, who shall have power to frame laws and conditions under which said certificates shall be granted.

41.—The underground workings of every coal-mine to which this chapter applies shall be under the daily charge of an underground manager and overman holding certificates under this chapter.

42.—A person shall not be qualified to be a manager, underground manager or overman unless he be the holder of a certificate under this chapter.

43.—If any coal-mine to which this chapter applies is worked for more than fourteen days without there being such a manager, underground manager or overman as is required by this chapter, the owner and agent of such mine shall each be guilty of an offence against this chapter.

Provided that the owner and agent of such mine shall not be guilty of an offence against this chapter if he proves that he had taken all reasonable means by the enforcement of this section to prevent the mine being worked in contravention thereof.

If for any reasonable cause there is for the time being no manager of a mine qualified as required by this section, the owner or agent of such mine may appoint any person holding a certificate as underground manager under this chapter to be

manager for a period not exceeding two months, or such longer period as may elapse before such person has an opportunity of obtaining, by examination, a certificate as manager under this chapter, and shall send to the Commissioner a written notice of the name and address of such manager and the reason of his appointment.

44.—A mine in which less than thirty persons are generally employed underground shall be exempt from the provisions of this chapter so far as relates to the appointment of a manager, unless the inspector by notice in writing served on the owner, agent or manager requires the same to be under the control of a manager; but the operations underground shall be under the charge of persons holding certificates as underground managers or overmen under this chapter, unless permission be given by the Commissioner that the operations underground may be under the charge of one such person.

45.—All certificates for managers, underground managers and overmen shall be issued by the Commissioner upon the report of the Board of Examiners appointed under the provisions of the law of mines and minerals.

46.—The Board of Examiners shall draw up rules for the guidance of their proceedings, and shall conduct examinations for granting certificates of competency under this chapter, and may from time to time make, alter and revoke rules for the conduct of such examinations and for determining the qualifications of applicants; so, however, that in every such examination regard shall be had to such knowledge as is necessary for the practical working of coal-mines in this Province, and for the determination of the qualifications of applicants for certificates of service as underground managers and overmen, and shall from time to time report to the Commissioner the names of the persons qualified to receive certificates, and shall do such other things as are necessary for the proper discharge of their duties under this chapter; and the Governor-in-Council shall have power at any time to alter and revoke any rules made by the Board of Examiners.

47.—The fees and travelling expenses to be paid to the Board of Examiners and the fees to be paid by applicants for certificates shall be determined by the Governor-in-Council.

48.—A register of the holders of certificates under this chapter shall be kept at the office of the Commissioner by such person and in such manner as he may from time to time direct.

49.—Persons holding certificates of competency granted by an English Secretary of State or other properly constituted authority in Great Britain may, upon passing the regular examination provided for in this chapter, be granted a certificate as underground manager or overman, but previous to the first meeting of the said board of examiners the said certificate, upon first being approved of by the inspector of mines, shall be valid.

50.—A certificate of service shall have the same effect only in the mine for which it was granted for the purposes of this chapter as a certificate of competency granted under this chapter.

APPENDIX VIII.—CHAPTER 8.—REVISED STATUTES OF THE REGULATION OF
MINES. PROVINCE OF NOVA SCOTIA. EXAMINING BOARD.

I.—*Certificate of Competency as Miner.*

Nc. 189

This is to certify that.....having undergone the examination required by the provisions of said Act, is hereby granted a certificate of competency as miner; but this certificate does not entitle the holder to take charge of a "working-face."

..... } **Examiners.**

II.—Certificate of Competency as Miner.

No. 189

This is to certify that.....having undergone the examination required by the provisions of said Act, is hereby granted a certificate of competency as miner, entitling the holder to take charge of a "working-face."

..... } **Examiners.**

III.—*Certificate of Competency as Shot-firer.*

No. 189

This is to certify that.....having undergone the examination required by the provisions of said Act, is hereby granted a certificate of competency as shot-firer.

..... } **Examiners.**

A vote of thanks was passed to Dr. Gilpin for his paper.